



*A Physicist
Remembers*

Richard J. Weiss



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A PHYSICIST REMEMBERS

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PREFACE

A funny thing happened to me on my way to a career in physics. World War II intervened and dumped me into the engine room of an aircraft carrier. Physics surrounded me — thermodynamics, kinetic energy, turbulence and mechanics were all there but no one was on board to discuss these subjects. The famous physicists were at Los Alamos. I was but a neophyte in the ship's bowels.

After Hiroshima my friends queried me about physics. They hadn't realized they were acquainted with such a smart fellow! I emerged as a wartime hero!

Richard J. Weiss

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INTRODUCTION

This scientific autobiography of Richard J. Weiss, protégé of MIT's John Slater and Bert Warren, traces the history of the 40-year effort to verify the predictions of quantum mechanics in describing the positions, momenta, and spin density of electrons on atoms. From this effort emerged the continuing worldwide Sagamore conferences to compare theoretical and experimental efforts in this field.

The research program began in 1950 when John Slater and four of his students joined the staff at Brookhaven and initiated Dr. Weiss into the intricacies of calculating electron distributions. With Slater's encouragement Weiss began an experimental program at Watertown Arsenal that eventually encompassed over 1000 physicists from most of the world intent on calculating and measuring the positions and momenta of electrons in crystals.

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THE EARLY YEARS

In 1926 a three-year-old lad, familiarly called Richie, of natural curiosity and living on the ground floor of a two family wood frame house on Teller Avenue in the Bronx, was invited upstairs to watch the older boys play with their electric trains. The tenants that occupied the second floor consisted of one teenager Sammy who tolerated the youngster's presence and three adults who scarcely took note of him. While Sammy's attention was momentarily diverted Richie sat on the tracks and was shocked into a fit of crying when he discovered what Benjamin Franklin had known two centuries earlier, i.e. urine was an excellent electrical conductor. Richie's entry into the field of physics was ass backwards.

Richie's first memorable encounter with gravitational attraction occurred but a few years later when his father's model T Ford was parked on the hill outside his home. The six-year old would sit in the vehicle, wiggle the steering wheel, and fantasize a journey along a highway. When he accidentally released the parking brake and the vehicle rolled down the hill, harmlessly stopping at the curbside, he had sense enough to jump clear but he was not clever enough to avoid the thrashing meted out by his father. His rear end was impacted by Newton's fourth law of motion — every irresponsible action had an equal and painful reaction. Between Franklin and Newton and a smarting derriere, Richie began to feel inversely dynamic about physics.

His mother referred to her son's behavior as precocious. Not true — Richie was a brat. At his aunt's wedding he brought confusion to the ceremony when he chased a black cat up the church aisle and then messed up the reception that followed by vomiting on the dance floor. He increased the local entropy well beyond that governed by the second law of thermodynamics. He should have been thrashed outright at the time but the solemnity of the occasion spared him.

In the year he was born the Yankee Stadium opened a few miles from where his family took up residence in the Bronx. Richie was but five when his father took him to see Babe Ruth. The Babe could steal the show in right field by diving forward to catch a low fly ball and then rolling over several times until his forward momentum was dissipated. This dramatic display of the interchange of linear and angular momentum matched the crowd's reaction to the Babe's dynamic appearances at the bat. From that day on baseball assumed a higher priority for Richie than intellectual pursuits.

The large density of youth in Richie's Bronx neighborhood spawned a myriad of games, stickball being one of the more popular. It required a street, everyone had one, a tennis ball or a plain rubber ball — somehow one could always be found — and a broomstick. This last item was more of a problem. The boys frequently approached their mothers with little success. "Mom, do you have any old brooms?" only bought negative replies. The lads broke or lost these broom handles faster than the broom heads wore out and many perfectly good household brooms had been sacrificed in the name of good fellowship. Richie's grandmother took to locking them in a closet — they still had a short half-life since closet doors had to be opened occasionally. But, in spite of these sporadic displays of domestic larceny, Richie was still considered by his mother to be a 'good' boy, although he never remembered using a broom in the manner intended by the manufacturer.

To further demonstrate his unpuritanical behavior during those youthful days, Richie's ire was aroused when the nearby baseball field was closed to hardball (too many windows were being broken). A sign was painted to notify the neighborhood youth of this restriction. Richie and a friend found a can of white paint and covered over the sign one midnight. Alas! The paint was merely whitewash and the rain erased their misdeed, exposing the original warning. Regrettably, softball forever replaced hardball on that field. Since softball was not the national pastime the event presented Richie with an unforgettable period of deprivation and

accompanying mental anguish. He and his friends would have to journey miles to find a grassy playing field.

Broken windows were not the sole peril in playing hardball in a populated neighborhood. On one occasion Richie's mother was walking on the sidewalk adjoining the ball field when a line drive struck her on the right side above the waist. She went down and we all ran to her. Almost unfazed she got up and assured us she was all right.

"Richie, your mother is the iron lady," remarked his friend.

He later learned his mother was wearing her armor plate. When Richie worked for the Army Material's Lab after the war he became interested in defeating projectiles and realized why his mother was unscathed in the incident. Her armor was called a girdle and it distributed the stresses over a large area. Physics will emerge in the darndest situations.

Acoustics played a role in Richie's youth. Mrs. Weiss had the best set of lungs on Teller Ave. When she called out "Richie!" a few times it traveled for several blocks and he'd come a running. His father had a subtler approach by whistling but two notes, an E with glissando up to a B. Why this carried as far as his mother's cry still remains a mystery. There is some interesting physics and physiology there.

Yet, scientifically naïve as he was, the laws of physics were ever ready to taunt him. A year before the stock market crash of '29, when the economy was still healthy, the family passed the summer on Coney Island. In spite of his mother's warning Richie spent the entire first day playing in the sand and running about on the beach, thus developing an excruciatingly painful sunburn. The UV portion of the sun's spectrum had done its damage. It was so painful that during his waking hours Richie took to sitting motionless in the kitchen. A woman visitor, noting his silence and immobility remarked, "Isn't he a good boy!" Even Richie was aware of the irony.

The huge three and four stack ocean liners that passed Coney Island on their way to and from their Manhattan piers fascinated the lad. It may very well have influenced his later

decision to join the Navy and to write a novel about the Lusitania. Such ships as the Majestic, the Leviathan, the Berengaria, and the Mauretania conjured up visions of adventure and enormity.

Richie's further awareness of the perils of gravity and sudden changes in momentum brought him his first life-threatening encounter when the sled on which he was 'belly whopping' down a hill skidded on a patch of ice and caused him to ram his midsection against a tree. The diminished friction between a steel runner and the ice landed him in the Morrisania Hospital for several weeks. The damage to his liver was agonizingly painful but fortunately self-healing. As he lay in the hospital visions of death haunted him and he wondered what he might have become if he had been given the chance to grow up. He never guessed he'd be a physicist, or a scientist, least of all an 'unpublished' writer.

Before WWII physics was a remote discipline that not one in a hundred fathomed, the other 99 assuming the word to be a generic term for Ex Lax or milk of magnesia. Save for Albert Einstein, a household name for genius, and the Nobel Prize, a household expression for overnight fame and riches, physics and its bare fundamentals were not formally disclosed to Richard until he entered Morris High School at age 16. The early entrance into secondary school resulted from his having been advanced a full grade thrice in elementary school. This was affected when the Assistant Principal Mr. Price decided to redistribute the teaching load by fingering the better students for instant promotion. He entered class in mid term, pointed at several students, and uttered, "you, you, you, you, and you — leave your books and follow me." It was all over in less than a minute. In those days Assistant Principals were intimidating and adept at getting things done. (Richie rarely saw the Principal who he later learned was a serious tippler, preferring to have his assistant do the work).

Only a week prior to one of those on-the-spot promotions Richie was ordered to bring his mother to see Mr. Price. He knew why. There was a redhead named Virginia in his class on whom he had a crush but could never garner the courage to speak to. Passing her on the way home she smiled at him. He was totally tongue-tied

and socked her to relieve the stress. Faced with the acid stares of Mr. Price, the girl and her mother, Richie found the words to apologize and from then on became a good friend of Virginia. She later entered a nunnery.

Experience became the young Bronxite's experimental method — like his first day in kindergarten when he ran into the little girls' room, quickly followed by the teacher who grabbed him by the ear and booted him into the boys' room. With only one bathroom at home he was too young to understand the nature of his 'misdemeanor' but in that brief moment at age five his innocence was wrested from him. He never did it again, the mark of a good experimentalist.

There was a mathematics teacher, Mr. Freeman, who tolerated no undisciplined behavior, rewarding the offender by grabbing his ear and pulling him out to the hall and leaving him there to face the stares of any who passed. Richie discovered that it was impossible to escape a firm hold on one's ear. Mr. Freeman should have realized that it was just such treatment by the conductor on a train that caused Thomas Edison's deafness when still a teenager. Richard's poor hearing would later surface whenever his mother asked him to go on an errand. Otherwise, Richard did well in Mr. Freeman's mathematics class; it was his low pain threshold around the ear lobes that received poor grades.

If anything inculcated in Richard an intellectual curiosity about the world, it had to be the hand-me-down set of 'The Book of Knowledge' that appeared in the house one day. Suddenly his life of baseball, stickball, basketball, and combating the Depression became enriched with cerebral matters such as mathematical puzzles. There were rainy days and the family didn't own a radio so 'The Book of Knowledge' was an awakening to a lore never discussed on the baseball diamond or while hanging around the local candy store.

The poverty of the early 30's left a deep imprint on Richard's psyche. Those days in the 30's, before Franklin Roosevelt and World War II turned the economy around, found many like his father feeling that capitalism had failed them. His

father spent years looking for steady employment and was too proud to accept the dole. Richard would be sent miles to buy day-old bags of Wonder bread and would return embarrassed when the neighbors spied him. In those days, before preservatives were added, stale rolls were a bit like concrete and only dunking in hot coffee made them palatable. Left-wing sympathizers spewed out verbiage during the Depression that captured Richard's imagination. His mother and grandmother, both devout, were brought to tears when he repeated some of the anti-establishment 'party line' he later heard in college.

But in spite of hard times his parents shielded him and his younger brother from its bitterness. His youth was immersed in athletics and, like all normal boys, he dreamed of a life as a baseball player. His close relatives suggested that Richie should have his sights on school teaching, a well-paying profession during the Depression. Attending Junior High School he found himself inspired by the teacher whose principal claim to fame was that the famous baseball player Hank Greenberg used to be in his class and, pointing to where Richard sat, identified the very desk. A classmate of Richard's, Gabriel Pressman was outstanding in English — his compositions demonstrated a professional command of the language far beyond that of anyone else in the class. Yet Richard still felt smug knowing that Gabriel couldn't throw a baseball. Furthermore who wanted a name like Gabriel? Pressman later became a successful reporter whose name would be frequently accredited with a story — who could forget a name like Gabriel Pressman? Still, the ghost of Hank Greenberg made a far greater impression on Richard. He was exuberant when it was announced in his senior year at high school that a baseball team was to be formed. Richard tried out but the coach took him aside and informed him that he was a good ballplayer but was too young for the team — no fault of his own but he was shattered — blame Mr. Price for the promotions.

In his first formal encounter with physics at High School Richard was scarcely impressed with the contents of the course although he still maintains a faint recollection of the instructor's

teaching technique. If it wasn't in the textbook it wasn't right. Richard concluded that the teacher really didn't understand the subject but was smart enough to keep one chapter ahead of the class. What a pity that the physics of baseball was not part of the course — that would have struck out two birds with one pitch. Physics teachers today could well benefit by approaching the subject from home plate.

As a senior in high school Richard felt trapped — there was no money for college and the job market was dismal in 1939. His father felt helpless in not being able to send Richard to college with a flowing green campus. Fortunately New York City boasted CCNY, a free school for the academically gifted. So for a registration fee of \$2 he enrolled in that crowded institution, a school that many years later even hired a physicist, Robert Marshak, as President. Having learned in later years that General Colin Powell attended both Morris High School and City College, Richard wrote to him and was pleased with his reassuring reply about the quality of education he had received at that college. He probably never sat at Hank Greenberg's desk, thought Richard, for then he may have achieved fame as an athlete rather than as a military genius!

For two years Richard boarded the 5¢ subway on The Grand Concourse at 170th Street and rode to mid-Manhattan where he attended crowded classes at the campus on 135th Street and Convent Ave. Walking up 135th Street one morning he spied a truck carrying tanks of bottled gas. The vehicle hit a bump and one of the tanks fell off causing the valve mechanism to rupture. The tank careened rapidly and spun aimlessly on the street as Newton's third law of motion came into play from the escaping gas. Richard ran for cover until the 2000 pounds of pressure had been reduced to naught. The sight and sound of such a catastrophe was unforgettable — it was a physics demonstration that presaged the rocket age a decade before its time.

Richard was a terrible student, spending most of his time practicing with the CCNY (Beavers) baseball team. But at the end of his second year he had to declare his specialization to the

academic authorities since degrees were not granted in baseball. Mathematician? He wasn't good enough. Chemist? The laboratory work was too sloppy for him. Biologist? He hated dissection. Physicist? Yes — it was the only scientific subject left and the least messy. Not surprisingly then, he again backed into the subject.

As a junior at CCNY he became a regular on the varsity baseball team, probably proving that he was a better baseball player than budding physicist or that the gifted kids that attended CCNY were not too well coordinated. The lacrosse team also practiced at Lewisohn Stadium under the tutelage of 'Chief' Charles Bender who took Richard aside one day and suggested he take up lacrosse, "A better game than baseball," the 'Chief' declared. Surprisingly enough the Chippewa native American 'Chief' Bender had been an outstanding pitcher for the Philadelphia Athletics from 1903 to 1914 and was elected to the Hall of Fame at Cooperstown in 1953. In 1942 Richard had never heard of him.

While some of the outstanding physicists in the world were beginning to concern themselves with uranium fission, and while the war in Europe drove most of that subject underground, Richard wrestled with the Introduction to Thermodynamics course given by Zemansky and with Atomic Physics delivered by Semat. The former course turned out to be almost totally devoted to mathematical manipulation of equations, the real world of thermodynamics escaped Richie's comprehension. Even boiling a pot of water to make tea enflowered no new romanticism or scientific significance from Zemansky's equations. Physics began to lose its appeal, if, indeed, there ever was any. Almost 40 years later Richard suddenly 'discovered' the subject of thermodynamics when Clarence Zener pointed out that the cusp in the specific heat of iron metal could be related to its magnetism. After the Zener lecture Richard remarked that at long last thermodynamics had displayed some usefulness! He went on to publish extensively on that subject.

It was early in 1941 when Richard's father bought a diner in Brooklyn and father and son would spend weekends running the

establishment. With not an iota of help from thermodynamics Richard learned the rudiments of short order cooking. It was one Sunday in December, while clearing the counter, that he heard about Pearl Harbor over the radio, and less than a year later Richard, still bearing memories of those ocean liners passing Coney Island, signed into the Navy V-7 program, permitting him to remain in college until the Navy needed him.

The summer of '42 approached with America gearing up to a wartime economy. In former years Richard had managed to find menial jobs during those summer holidays but this time he got lucky. The State unemployment office sent him to a large unmarked building on Seventh Ave. in downtown Manhattan where he was offered a job as a custodian. Half an hour later he found himself sweeping the floors of the wartime Office of Censorship, a multistory building and former mattress factory with thousands of employees reading and excising foreign mail.

He asked his supervisor, who took a shine to the lad, if there might be something else he could do. The only thing he really knew about brooms was how to saw off their handles for stickball. When he bragged that he was good in mathematics he was reassigned to the Leave Department, calculating by hand the amount of annual and sick leave employees earned, and deducting what had been used by each worker. At least half the employees, expert in their own language, presented a problem for Weiss in trying to explain in English the somewhat complicated system for amassing and using leave. Furthermore, he was seated near the door leading to the Ladies' room and the passing pulchritude imposed an added burden in trying to concentrate on his math. Diplomacy was also required. Employees could only be credited with sick leave if they presented Richard a note from a doctor. An order from on high denied sick leave for all dental visits. When Weiss tried to explain this to someone who had suffered an impacted tooth but spoke only an African dialect his resourcefulness was tested to its limit.

Unclaimed paychecks due to illness were left with Weiss with instructions to only hand them out with proper identification.